

# Oxidation Resistant Rocket Thrusters for High Performance Propellants

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## INNOVATION

Chemical vapor infiltration process to fabricate low-cost, functionally graded ceramic matrix composites

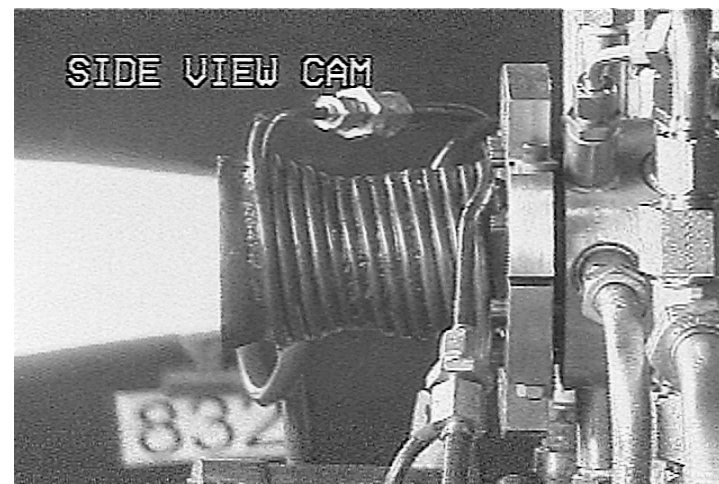
## ACCOMPLISHMENTS

- ◆ Developed rapid chemical vapor infiltration (CVI) process that leads to reduction in processing time and higher matrix densities. Fabrication times reduced by a factor of seven with up to a ten fold reduction in the fabrication cost
- ◆ Rapid CVI leads to directional matrix growth and to functional grading through the fiber preform. Lightweight  $C_{(f)}/C$  graded Ceramic Matrix Composites (CMCs) were fabricated which behave like Re or HfC, with density of less than  $3g/cm^3$
- ◆ Thrust cells tests with  $O_2$  &  $H_2$  propellants at operating conditions for 30 seconds showed no erosion at the throat
- ◆ Tested components in air at 4300F for 6 minutes. Excellent thermal stability was shown

## COMMERCIALIZATION

- ◆ Patent applied for February 2000-Docket Number 1388
- ◆ Received \$140K Phase III from MSFC
- ◆ Collaborating with commercial partners to develop components for liquid and solid Divert & Attitude Control System (DACS) and for flightweight, scramjet systems

Glenn Research Center  
Marshall Space Flight Center  
Materials  
3-079



*Functionally graded CMC thrust cell  
during evaluation at NASA Glenn*

## GOVERNMENT/SCIENCE APPLICATIONS

- ◆ Hypersonic vehicle propulsion components are presently being evaluated under the DARPA HyFly Program
- ◆ This new family of lightweight materials will provide oxidation and erosion resistance for next generation NASA and DoD propulsion applications
- ◆ Divert and attitude control propulsion thrusters are presently being tested under BMDO and AF programs

1993 Phase II, NAS3-27272, 1/02  
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